

Blood droplet spreading/imbibition over porous substrates:

complete and partial wetting

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Dried blood spots (DBS) is a new blood sampling method which is utilised for blood sample collection, storage and transportation. During DBS application a thin porous substrate, such as cotton fibres, cellulosic fibres and polymer membrane etc., is used as an absorbent sponge where blood droplet from a fingertip or syringe is collected. Then, the collected blood is preserved as a dried spot sample [1]. Accordingly, the whole process of DBS sampling could be considered as spreading of non-Newtonian fluid (blood drop) over porous substrate (DBS card) with simultaneous spreading and imbibition over and inside the porous substrate.

The spreading and wetting of porous substrate by blood are complex process depending on the physical and chemical properties of both liquid and substrate. Blood spreading/imbibition has been investigated in the case when the liquid wets completely the porous substrate [2, 3]. Here the spreading behaviour of DBS sampling is investigated in the case of partial wetting and the results are compared with the case of complete wetting. Nitrocellulose membranes (NCM) with different pore size and silanized Whatman 903 blood saving card have been used as porous substrates. The spreading experiments have been applied to obtain the time evolution of spreading parameters, such as, radius of droplet base and wetted region, and dynamic contact angle.

The result of spreading on NCM showed that the spreading process was a partial wetting spreading with three subsequent stages: initial fast spreading, constant maximum droplet base and the shrinkage of the drop base. However, in spite of silanization of the Whatman 903 filter paper, the blood droplet showed a complete spreading behavior with two subsequent stages: initial fast spreading and the shrinkage of the drop base. A separation of red blood cells (RBCs) and blood plasma has been found in the case of the blood drop spreading over 0.2 and 3.0 μm NCMs in which the RBCs are mostly collected on the membrane surface and plasma is collected inside the membrane pores [4]. Important to notice that the RBCs were not damaged during this process. This opens a completely new opportunity to (1) investigate RBCs and plasma separately; (2) to use this method for non-destructive separation of living cells from aqueous solutions.

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